

**THE ECONOMIC IMPACT ON PLUMAS COUNTY OF
ALTERNATIVE NORTHERN PIKE ERADICATION AND
MANAGEMENT SCENARIOS FOR LAKE DAVIS:
A PRELIMINARY REPORT**

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Table of Contents

Tables.....	4
Executive Summary	5
Introduction.....	6
Purpose of the Study	6
Cautionary Notes	6
Economic Impact Analysis	8
Resource Valuation.....	9
Background.....	9
Plumas County	9
Northern Pike in Lake Davis.....	10
1997 Pike Eradication Efforts	10
Pike Population Management	11
Program Results	11
Scenarios Analyzed.....	11
Scenario 1: Preferred Alternative.....	11
Scenario 2: Complete Dewatering of the Reservoir	12
Scenario 3: Draw Down to 48,000 Acre Feet	13
Scenario 4: No Action.....	13
Survey and Results.....	13
General.....	13
Visitor Spending	14
Impact of Presence of Northern Pike	14
Effect of Catch Rate on Annual Visits.....	14
Methodology	15
Estimating Total Annual Visitor Days.....	15
Visitor Spending by Category.....	16
The IMPLAN Input-Output Model.....	17
Estimated Local Impacts per 10,000 Visitor Days	17
Estimated Impacts for 2005	19
Study Results: Local Economic Impacts	21
Assumptions.....	21
Scenario 1: The Preferred Alternative	22
Scenario 2.....	23
Scenario 3.....	24
Scenario 4.....	25
Economic Impacts by Pike Management Scenario.....	27
Successful Eradication vs. Ongoing Pike Management	27
Failed Eradication vs. Ongoing Pike Management.....	27
Conclusions.....	29
References.....	30
Appendix A.....	32
Resource Valuation.....	32
Data Sources	33
The Model and Variables Included.....	33
Estimated Equation	34

Coefficient Estimates	35
The 2005 Value of the Lake Davis Fishery Resource to Freshwater Anglers.....	36
The Impacts on the Value of the Lake Davis Fishery Resource for the Preferred Alternative and No Action Alternative Scenarios	36
Appendix B	39

Tables

Table 1: Estimated Annual Recreational Visitor Days at Lake Davis

Table 2: Local Visitor Spending: Total and Expenditures Per Visitor Day

Table 3: Impacts on Plumas County Output, Income, and Employment per 10,000 Visitor Days

Table 4: Total Income Impacts by Sector per 10,000 Visitor Days

Table 5: Estimated 2005 Income Impacts on the Plumas County Economy

Table 6: Estimated 2005 Income Impacts by Industry

Table 7: Estimated 2005 Impacts on Output (Gross Sales), Employment, and Plumas County Revenue

Table 8: Visitor Days and Impact on Plumas County Income for the Preferred Alternative: Successful and Failed Eradication Efforts

Table 9: Visitor Days and Impact on Plumas County Income for Scenario 2: Successful and Failed Eradication Efforts

Table 10: Visitor Days and Impact on Plumas County Income for Scenario 3: Successful and Failed Eradication Efforts

Table 11: Visitor Days and Impact on Plumas County Income for Scenario 4: No Action Alternative

Table 12: Impacts on Plumas County Output (Gross Sales), Income, Employment, and County Revenue: Successful Eradication Scenarios (Scenarios 1-3) and Ongoing Pike Management (Scenario 4)

Table 13: Impacts on Plumas County Output (Gross Sales), Income, Employment, and County Revenue: Failed Eradication Scenarios (Scenarios 1-3) and Ongoing Pike Management (Scenario 4)

Table 14: Impacts on Plumas County Output (Gross Sales), Income, Employment, and County Revenue: One-Time Failed Eradication Scenarios (Scenarios 1-3) and Ongoing Pike Management (Scenario 4)

Table A1: Regression Coefficients, Standard Errors, and T-Values

Table A2: Regression Statistics: Adjusted R-Square and F-Value

Table A3: The Value of the Lake Davis Fishery Resource under Scenarios 1 and 4

Executive Summary

Ranking the alternative methods of dealing with the northern pike problem in Lake Davis is relatively straightforward when the sole criterion is the economic impact on the Plumas County economy. The analysis contained in this report supports the conclusion that eradication is preferable to the current management program. Compared to the use of the current pike management program alone, even a failed attempt at eradication yields a better economic outcome for Plumas County. Among the alternative methods of eradication proposed scenario 3 yields the greatest local economic benefits, although scenario 1, the preferred alternative, is a close second. Both are preferable, on the basis of economic impact, to scenario 2 since the latter implies the loss of the recreational use of the lake for a full three years.

For each of the scenarios Plumas County income was estimated for a 22 year period or two eradication cycles. For the three eradication scenarios (scenarios 1-3) the total income impacts for successful eradication are \$20.42 million, \$18.56 million, and \$20.70 million (in undiscounted constant 2005 dollars) respectively. The multiple failed eradication case (one of two failed eradication cases considered, the other being just a single attempt) leads to 22 year income impacts of \$16.34 million for scenario 3, \$15.75 million for scenario 1 (the preferred alternative), and \$15.13 million for scenario 2. For all eradication scenarios, estimated income impacts, even where eradication efforts fail, exceed the contribution Lake Davis will make to Plumas County income with a continuation of the current pike management program alone (scenario 4). It is estimated that continued pike management without an attempt to eradicate the pike will generate only \$10.35 million in local income over the next 22 years.

The choice between scenarios 1 and 3 is a difficult one and one that cannot be made on the basis of economic impact alone. For the successful eradication case there is a difference of just under \$22,000 in the annual effect on gross sales and less than a \$13,000 difference in the impact on annual local income. While the differences are greater for the failed eradication case, the disparity is insignificant relative to the gap between the successful and failed eradication cases. If eradication were to be unsuccessful, and were to be repeated periodically (every 11 years in this case), under scenario 3 annual gross business sales would average \$338,300 less (over the 22 year period used in the analysis) than for the successful case. In addition, annual income would be lower by an average of \$198,300. The disparity between impacts on gross business sales and local income are likewise significant for scenario 1, the preferred alternative. Under this option a failed eradication effort with multiple attempts would reduce average annual gross sales and local income by \$362,500 and \$212,400, respectively.

On the basis of economic impact on the Plumas County economy, a pike eradication effort by any of the proposed methods is preferable to continuing the current pike management program alone. And, since the differences in the impacts among the alternative scenarios are insignificant (at least for scenarios 1 and 3) relative to the local

economic cost of a failed eradication attempt, the particular eradication method chosen should be the one having the greatest probability of success.

Introduction

Purpose of the Study

The purpose of this economic study is to examine the short- and long-term economic effects of pike and pike eradication efforts both locally and statewide. There are three key elements to the economic analysis that need to be completed in order to accomplish this purpose. The first is to estimate the economic impacts of pike eradication efforts on the Plumas County economy. Second, a travel cost study is undertaken to estimate the value of Lake Davis to all recreational users including those from outside of the county. Since the existence of a pike population in Lake Davis presents a risk of release to downstream waterways, the third element of the economic analysis is an estimate of the statewide economic costs of the establishment of a self sustaining pike population in California's rivers and streams.

Of particular concern is that pike will become established in the Thermalito Afterbay, Yolo Bypass, and the Sacramento-San Joaquin Delta with adverse consequences for these important freshwater fisheries and the anadromous fish species dependent upon those waterways. In addition, the presence of pike may impose additional costs in the form of required changes in the water delivery schedule or other limitations on movement of water through the Sacramento-San Joaquin Delta. These waterways, "...as well as many aquatic environments in other California watersheds, match the preferred habitat of the northern pike in terms of temperature, aquatic vegetation, current speed and other features". (DFG 2005)

The study examines the economic costs and benefits of several pike eradication scenarios. It will function as an informational document for the California Department of Fish and Game (DFG) and the general public in regards to the relative economic effects of various methods to eradicate pike including the no project alternative. This economic study is being conducted separate from, but in parallel with, a joint Environmental Impact Report/Environmental Impact Statement being prepared by a private consultant under contract with the DFG.

Cautionary Notes

Possible Changes in Local Impact Estimates

This is a preliminary report, and as such, the conclusions need to be interpreted with a note of caution. Since the contract was not signed until September 2005, angler surveys were administered only during the mid-September through mid-October time period. Additional surveying will be completed during late May and June of 2006 and the results of those surveys will be included in the final report scheduled for release in August of 2006. While the pattern of recreational use of the lake determined by our surveys is consistent with what has been observed in previous angler surveys done by the California

Department of Water Resources (DWR) and DFG, it is possible that the additional surveys will alter the value of some key variables. (DWR 2005, DFG 2003a, 2003b, and 2003c) For example, expanding the sample might lead to a change in estimated local spending per visitor day and that would change the estimated local economic impact of the project alternatives. However, the consistency in the in the visitor spending data observed throughout the survey process makes it highly unlikely that the final estimates will be more than 25% higher or lower than those contained in this preliminary report.

Statewide Impacts

In addition, the statewide economic impact analysis contained in this preliminary report is incomplete. Since the statewide impact of possible escapement and establishment of downstream pike populations was not available at the time this preliminary report was written, that analysis is not included here. Also the results of the travel cost study, intended to determine the value of the Lake Davis recreational resource to all users may change with the information derived from the additional surveying planned for early next summer.

Local Government Revenues

The estimated impacts on Plumas County revenues are more imprecise than what will be included in the final report and are approximated as 25% of indirect business taxes. This gap in the analysis will, of course, be filled in time for the release of the final report in August, 2006.

Impacts on Local Property Values

The analysis contained within this report estimates four local economic impacts associated with pike eradication efforts at Lake Davis: gross sales, income, employment, and county government revenues. There is another possible impact that is not included and that is the potential transitory impact on local property values that might be experienced during the treatment process. There are two reasons for excluding this potential impact, the most important of which is that it is impossible to determine with any degree of precision. The excluded effect is that local recreational property might become less attractive to buyers from outside of the county. This could occur for two reasons: because the lake level has been lowered during the treatment process and thus is unavailable for a period of time that depends on the scenario chosen, or because of the adverse publicity associated with the real or imagined consequences of the treatment itself. The impact of the lake closure should, at most, be the interest cost of delaying property sales for the period of time the lake is closed and is not likely to be significant relative to the estimated impacts on local income contained in the report.

Second, the effect on property values generated by changes in local income is already included in the local economic impact estimates. Income impact estimates include the effect on property income and thus including a property value impact would involve double counting.

Some might point to the effects on property values experienced during the 1998 treatment as evidence that this impact is large and should not be excluded from the analysis

contained within this report. However, examination of that evidence is likely to lead to the conclusion that the effects of closure of Lake Davis during those years cannot be separated from the other factors that affected property values in the mid to late 1990's. Rising interest rates and other national and state economic factors depressed real estate prices throughout California and recovery of real estate prices did not begin in earnest until interest rates declined after the year 2000.

Plumas County did experience a decrease in new homes permitted (one measure of property related activity) in 1999. The decrease was from 123 in 1998 to 101 in 1999, or less than an 18% decrease. By the year 2000 housing permits had increased to 188, with increases to 191 and 260 in the next two years. By way of comparison, Lassen County experienced a decrease in new homes permitted of 31% from the 1996 peak to the activity level in 1997 and 1998, with recovery to the 1996 level delayed until 2002. Adjacent Yuba County saw a surge in building activity in 1999 (probably due in part to damage from the 1997 flood), a 62% decline in new housing permits issued in 2000, and rapid growth in building activity beginning in 2002. Sierra County experienced a decrease in new housing permits issued of almost 41% for 1997 and 1998 from the year 1996 with a return to 1996 levels in the year 2000. In general, while the timing is not precisely the same, surrounding counties experienced larger percentage downturns in late 1990's housing construction activity than did Plumas County. (DOT 2005)

Economic Impact Analysis

The economic impact analysis performed for this study is used to estimate the effect on local economic activity of the various pike eradication scenarios. There are five key elements to this analysis. First, the amount of spending per visitor day is established for several important industry specific categories. This information is derived from the surveys administered at various Lake Davis boat ramps by employees of the Center for Economic Development (CED) at the California State University, Chico. Second, the total number of annual visitor days is estimated. This is accomplished using the CED surveys and counts, the DFG angler surveys, and campground usage data obtained from the U.S. Forest service. Spending per visitor day by industry sector is multiplied by the estimated total of visitor days to determine total spending by industry category. The third element of the analysis is to use the industry spending data in conjunction with the IMPLAN input-output model to calculate the annual impacts of Lake Davis recreational use on Plumas County output, income, employment, and county revenues. Fourth, adjusting for effects of fishery quality on lake usage and the amount of time the lake would be unavailable under the various pike eradication scenarios, allows computation of the relative economic impacts of the four scenarios analyzed. Finally, these economic impact estimates, combined with additional data on local expenditures by the DFG (associated with pike eradication options), permits estimation of the net economic impacts on Plumas County for each scenario.¹

¹ Due to their unavailability at the time this report was written the cost figures and the local impacts of eradication expenditures are not included.

While the majority of the economic impacts are likely to be felt in the City of Portola, the analysis is performed for Plumas County as a whole. It would be possible to separate the impacts for Portola from those of the remainder of the county by running the IMPLAN model at the ZIP code level. However, the authors' previous experience with IMPLAN is that the smaller the defined economic unit, the less reliable the estimates.

The local economic impacts contained in this report can be interpreted as worst case estimates. First, this is true if the county-wide impacts are assumed to represent the effect on the Portola economy. Second, there is the implicit assumption that all of those recreational users of Lake Davis will find other options outside of Plumas County. That, in fact, may not be the case and therefore a portion of the estimated visitor spending may still positively affect the local economy.²

Resource Valuation

Estimation of the value of the Lake Davis is accomplished using a travel cost model. The use of travel cost to estimate the demand for recreational sites was first suggested by H. Hotelling in the late 1940's. The model was further developed by Knetsch and Clawson in the 1950's and 1960's and has since gained broad acceptance among resource economists. The literature in resource and environmental economics contains numerous studies using variations on the travel cost model.

This approach to valuing a resource is based on the idea that the cost of getting to a recreational site is a measure of the value individuals place on its use. A demand curve is generated from the various travel costs and the associated number of trips. It is fundamental to economic theory that the higher the price of a good or service the smaller the quantity demanded. In the vernacular of the travel cost model this means that as travel cost increases, as it does with distance from the site, the smaller the number of trips made annually. The total value of the resource is estimated as the area under the generated demand curve but above the average travel cost for all surveyed users. In order to maintain the continuity of the economic impact analysis, the results of the travel cost study are included in Appendix A instead of the main body of the report.

Background

Plumas County

Plumas County is located in Northern California, bordered by Lassen County on the north and Sierra and Yuba counties on the south. In 2004 Plumas County had a population of 21,230 and total wage and salary employment of 7,630. The average salary per worker was \$35,840. With total county personal income of \$632.23 million, 2004 per capita income was \$29,780, and median household income was estimated at \$53,900.

² Sixty percent of those responding to the survey indicated that they would "definitely" or "probably" come to the area even if Lake Davis were unavailable.

Wage and salary employment grew by 50 jobs during 2004, representing a slowdown from the rate of job growth experienced in the four previous years. Most of the jobs created during 2004 were in leisure services, retail trade, construction, and agriculture, with retail trade adding 80 jobs during the year. Employment in some other sectors actually declined, with the largest decrease in the government sector which lost 81 jobs. Annual employment growth is expected to increase to 150 new jobs in 2005, and then to stabilize at between 50 and 100 new jobs annually through the year 2025.

In 2004 the Plumas county population increased by 0.6%, while the population of the incorporated city of Portola declined by 0.5%. The county's rate of population growth through the year 2025 is forecast to remain below the state average and is expected to increase at 0.6% annually for the 2005-10 period and remain well below 1% annually through 2025.

Real per capita income is forecast to increase by 1.8% in 2005, slowing to a 0.8% rate of increase over the next five years. Taxable sales are also expected to grow in 2005 at a rate above the long term trend, or by 4%, slowing to an average of 2.1% annually over the next five years. In nominal terms (unadjusted for inflation) the rate of growth in taxable sales is forecast to grow at a 4.02% annual rate through the year 2025. Through the year 2025 nominal personal income is forecast to grow at a 2.95% annual rate, with an annual real rate of growth averaging less than 0.5%. (DOT 2005)

Northern Pike in Lake Davis

Lake Davis is located in the Feather River drainage of the Sacramento River system at an elevation of 5,775 feet. The dam creating the lake was constructed by the California Department of Water Resources (DWR) in 1967. It is located near Portola in Plumas County on Big Grizzly Creek, a tributary to the middle fork of the Feather River. It has a storage capacity of 84,371 acre feet, covers 4,026 acres, and has a mean depth of 20.5 feet. (Lee 2001)

The existence of northern pike in Lake Davis was initially confirmed by an angler catch in August of 1994. Northern pike were caught with increasing frequency through 1994 and 1995 and in 1995 the DFG "...concluded that the eradication of the predatory pike was necessary in order to prevent their further spread in the state and to protect the trout fishery in Lake Davis". (Lee 2001, DFG 2003)

1997 Pike Eradication Efforts

The DFG received the necessary permits by October 1997 and on October 14, 1997 treatment with powered rotenone and liquid Nusyn-Noxfish began. The lake still held 50,000 acre feet at the time of treatment, 20,000 acre feet more than it would have had the project not been delayed by a restraining order. By late November of that year it was determined that most of the treatment chemicals had degraded except for pipernyl butoxide. The persistence of this synergistic chemical was aided by a thick icecap and low water temperatures, and because of its presence, restocking with rainbow trout was

delayed until June of 1998. Unfortunately in May 1999 northern pike were again discovered in Lake Davis. (Lee 2001)

Pike Population Management

Following a May 1999 meeting between DFG Director Robert Hight and members of local communities, a task force was formed to study pike management options and to develop recommendations. Input concerning potential alternatives was sought from the public, and, fishery biologists and others having direct experience with pike population management were brought in to discuss and evaluate suggested control strategies. In January of 2000 the task force steering committee and DFG jointly authored a report entitled *Managing Northern Pike at Lake Davis: A Plan for Y2000* containing a series of recommended strategies for northern pike population control. (Lee 2001, SLDTFSC/DFG 2000)

Program Results

In September 2003 DFG published a report outlining the results of over three years of northern pike population management at Lake Davis. The report concluded that, although field crews removed 28,100 pike weighing 4,250 pounds, the yearly harvest continued to increase and pike density increased through at least the first three years of the program. There were two important adverse consequences resulting from the failure of the implemented management techniques to limit pike populations. First, due to increasing numbers of northern pike, the risk of release to downstream waterways has increased. Second, the catch rate for rainbow trout had declined substantially, falling from a rate of 0.28 per hour in 2000 to 0.12 per hour in 2003. (DFG 2003) The decline in trout fishing success in all likelihood imposed economic costs on the local economy with a 33% decrease in visitor days recorded at Lake Davis campgrounds between 2000 and 2004. (USFS 2005)

Scenarios Analyzed

Scenario 1: Preferred Alternative

Description

The preferred alternative involves drawing the lake down to a volume of between 10,000 and 20,000 acre feet and then applying a liquid rotenone formulation in order to eliminate the pike. The rotenone treatment would also extend to tributaries to the lake, wetlands, and other potentially infested areas within the Lake Davis watershed. Drawdown would take place between January and September of the project year, and depending on the rainfall year, would result in a volume of water within the lake of 10,000 to 20,000 acre feet by September of the same year. Neutralization of the rotenone will occur by one of a number of methods currently under evaluation. (DFG 2005)

Impacts on Fishery and Lake Availability

Lake Davis boat ramps will be unusable when the lake level drops below 40,000 acre feet. With the draining commencing in January of year 1 that level is likely to be reached by March of the same year. Following eradication, trout will be restocked in May of year 2 and at that time the lake will be available for the full spectrum of recreational uses. It is assumed that successful eradication of pike will lead to an improvement in the trout fishery of 100% by year 5.³ If eradication efforts are unsuccessful it is assumed that it will be a periodic effort (e.g. once every 11 years) or will be attempted just once and the trout fishery will improve by 100% by year 5 and decline to pre-treatment levels by year 11. If just one treatment is attempted the fishery quality will continue to decline after year 11 until the catch rate falls by an additional 50% by year 21.

Scenario 2: Complete Dewatering of the Reservoir

Description

This alternative involves the use of existing dam outlets and pumps and the use of additional piping and siphons. Installation of structures will be necessary in order to prevent downstream release of adult pike, juveniles, larvae, or eggs. In the summer or fall, and when lake volume reaches 90 acre feet, the remaining water and all inflow will be treated with rotenone. (DFG 2005)

Impacts on Fishery and Lake Availability

Under this alternative Lake Davis boat ramps will be unusable between March of year 1 and April of year 4. Following eradication, trout will be restocked in May of year 4. Successful eradication is assumed to lead to the same improvement in trout fishery quality described under the preferred alternative. As with the preferred option, the impact of this method will be evaluated under the alternative assumptions that eradication of pike is a successful one-time event, that it is unsuccessful and will be repeated periodically, or that it is attempted just once. The impact on catch is assumed to follow the same post treatment patterns used in the analysis of the preferred alternative.

³ In 2000 the catch rate for trout in Lake Davis was 0.28 trout per hour, but by 2003 that rate had declined to 0.12, presumably due to increased predation by northern pike. Thus removal of pike from the lake should result in a comparable reversal of the catch rate, leading to more than a 100% increase in the number of trout caught per hour. Even though an increase from 0.12 to 0.28 is more than a 100% increase, it is assumed that the quality of the fishery increases by just 100%. That is because quality (and angler response to quality changes) is also affected by the size of fish caught and the average size of trout caught has increased significantly over the same period. (DFG 2003, Loomis 2005)

Scenario 3: Draw Down to 48,000 Acre Feet

Description

For this alternative the minimum lake level will be 5,767 feet above sea level and the lake volume will not fall below 48,000 acre feet. The standing water and all flowing water will be treated with liquid rotenone in the summer or fall of year 1. Until treatment occurs boat ramps will remain usable. Restocking will be done in late spring of year 2. (DFG 2005)

Impacts on Fishery and Lake Availability

This option somewhat reduces the time the lake will be unavailable (boat ramps can remain open), however since trout will not be restocked during year 1 and the lower water level will reduce the aesthetic value of the lake for recreation, use during year 1 is likely to be reduced substantially. Successful eradication is assumed to lead to the same improvement in trout fishery quality described under the preferred alternative. As with the preferred option, the impact of this method will be evaluated under the alternative assumptions that eradication of pike is a successful one-time event, that it is unsuccessful and will be repeated periodically, or that it is attempted just once. The impact on catch is assumed to follow the same post treatment patterns used in the analysis of the preferred alternative.

Scenario 4: No Action

Description

Under this option there will be no attempt to eradicate the pike from Lake Davis. The current management plan, implemented to control the numbers of pike in the lake, will be continued. This option might include continued stocking of trout, although it is likely that a change towards larger fish, less susceptible to predation by pike, will be desirable. (DFG 2005)

Impacts on Fishery and Lake Availability

If this option were chosen there would be no interruption in the availability of the lake for recreation. Under the continued stocking alternative the quality of the trout fishery is assumed to decline with average trout populations declining 25% by year 5 and 50% by year 10. (DFG 2005)

Survey and Results

General

Surveys and visitor counts were conducted at Lake Davis on 13 days between September 17, 2005 and October 21, 2005 for a total of 162.5 hours. Over that time interval 195

parties were observed representing 384 individual visitors. Of those 195 parties, 151 filled out the detailed survey form (see Appendix B for the actual form used). Interviews were conducted at four boat launch points including Honker Cove, Mallard Cove, Eagle Point, and Camp 5. Some refused to be surveyed, but the majority of those approached willingly participated.

There was an average of 1.8 individuals per interviewed party with 97.5% of those interviewed visiting from outside of Plumas County. The duration of the average visit was 2.66 days, while the average visiting party makes 2.67 trips to Lake Davis annually. Most visitors (90.68%) listed the primary purpose of their visit as fishing, with 6.21% visiting friends and the remainder traveling to the area for business or other recreation. Just fewer than 70% of surveyed visitors stayed in the local area, with 38.1% of those staying locally utilizing campground facilities, 22.9% staying in hotels or motels, 16.2% staying with friends, and the remainder listing “other”, primarily second homes.

Visitor Spending

Local expenditures for all surveyed parties totaled \$26,522, or \$35.60 per visitor day. The expenditures were entered into six separate categories for use in the local impact analysis. Local spending per visitor day was \$8.09 for restaurant meals, \$8.08 for lodging, \$8.86 for transportation, \$2.73 for fishing-related spending, \$5.24 for groceries, and \$2.60 for other local retail.

Impact of Presence of Northern Pike

Of those surveyed 97.53% were aware of the presence of northern pike in Lake Davis. Most (86.62%) indicated that it did not affect their willingness to utilize the lake fishery. For the few individuals saying that it did affect the number of annual visits, four said the presence of northern pike in the lake increased the number of annual visits, while 11 said that knowledge reduced the number of annual visits. However, when considering the impact of pike predation on the trout catch rate, there is likely to be a substantial negative impact on annual use of the Lake Davis fishery.

Effect of Catch Rate on Annual Visits

Only 27.33% of surveyed anglers reported that they typically caught their daily limit of trout at Lake Davis. When asked if they would increase their annual visits to the lake were they to catch twice as many fish daily, 77.36% answered yes, with an average increase in annual visitation of 112.39%. Adjusting for the percent currently catching their limit and those who indicate no impact on their annual visitation, the implication is that a doubling of the catch rate would lead to a 63.2% increase in annual visitor days.

Those who currently catch their daily limit were asked if a halving (a 50% decrease) in their daily catch rate would affect the number of annual visits to Lake Davis. For those answering the question, just over 50% said that it would decrease their annual use of the

lake, with an average reported decrease of 38.81%. However, the relatively small sample size (13) makes the estimates of questionable value and they are not used in this report.

Methodology

Estimating Total Annual Visitor Days

Data Sources

In order to estimate the local economic impacts of Lake Davis recreational use it is necessary to determine the total annual visitor days for lake users from outside Plumas County. Since no actual count has been made, usage must be estimated from sampling. There are three sources of data that permit estimation of annual use. First, the U.S. Forest Service (USFS) maintains a count of individuals using their campground facilities at the lake. Second, the California Department of Fish and Game (DFG) has done angler surveys and the summary data includes a total count for the days surveyed. Third, surveys were administered and counts made during September and October of 2005 by employees of the Center for Economic Development (CED). The range of estimates annual visitor days derived from the three sets of data is 13,291 to 22,360. Table 1 summarizes the estimates and a brief description of how each estimate was obtained is included in the following three sections.

Table 1: Estimated Annual Recreational Visitor Days at Lake Davis

<i>Primary Data Source</i>	<i>Description</i>	<i>Annual Visitor Days</i>
USFS Campground Data	Campground use for the years 2001-2005	22,360
DFG Angler Surveys	Based on 2001 angler counts unadjusted	18,041
DFG Angler Surveys	Based on 2001 angler counts adjusted to 2005 using USFS relative campground use	13,291
DFG Angler Surveys	Based on the average of five years of count data collected between 1986 and 2004	16,344
CED Surveys	Based on the average hourly count of recreational users	20,458
CED Surveys	Based on the average hourly weekday and weekend day count of recreational users	17,697

U.S. Forest Service Campground Usage Data

Campground usage data was obtained from the USFS for the years 1996 through 2005. The annual average for the ten year period was 28,807 campers with peak use in 2001, followed by a steady decline, falling to 20,653 campers by 2004. There was a slight increase in 2005 to a total of 21,569 campers. The annual use of Lake Davis in 2005 is obtained by taking the number of campers in that year and adjusting for the number who would come even if the lake were unavailable for use.

In May and June of 1998, prior to the restocking that followed chemical treatment, the total campers at the USFS Lake Davis campgrounds totaled 584, or 6.7% of the 8715 camper 1999-2005 May-June average. Assuming that the difference represents recreational users of the lake, that would imply that 20,124 of the campers are there only because of the availability of the lake. Since the CED survey determined that 90% of all lake users camp, this implies that total annual use by non-residents is 22,360 visitor days.

California Department of Fish and Game Angler Surveys

DFG surveys were administered for a number of years, involving twenty-eight days of surveying and angler counts between late April and early November. The 2001 survey is used here for purposes of estimating total annual angler use. In that year angler counts were obtained on twenty-eight days between April 28 and November 15. A total of 542 anglers were counted, or an average of 2.647 per hour. Adjusting for the 2562 fishing hours available annually (14 hours per day for 183 days) that leads to an estimated 2001 angler use of 18,041 visitor days. Adjusting for the difference in campground use between 2001 and 2005, results in an estimated 13,291 visitor days for 2005. If the average for the five years for which the DFG completed counts is used (excluding 1998), annual visitor days are projected to be 16,344. However, since the DFG counts include anglers only, both of these figures probably underestimate total annual visitor days by at least 10% (90% are primarily visiting to fish).

Current Survey Data Collected for This Study

Survey data collected by CED employees is used to obtain two separate estimates of annual visitor days at Lake Davis. First the average number of recreational users counted per hour of surveying, 2.363, is used to estimate use for September of 2005. The estimate of 2,347 visitor days is then divided by the ratio of total campers in September to the annual total, or 12.91% for 2005. Using this approach the estimated annual non resident usage of Lake Davis for the year 2005 is 20,458 visitor days.

A second method, using separate visitor counts for weekdays and weekend days, yields a lower estimate. Hourly counts for weekend days (3.07) and for weekdays (2.45) are multiplied by the available annual weekend and weekday fishing hours (for May 15-November 15), respectively. Estimated annual visitor days at Lake Davis for 2005 are 17,697 using this approach.

Visitor Spending by Category

Each surveyed visitor was asked to estimate his or her local spending delineated by six expenditure categories: restaurant meals, lodging, transportation, fishing related, groceries, and other local retail. The results are included in Table 2, summarized by total reported spending and spending per visitor day.

**Table 2: Local Visitor Spending: Total and Expenditures
Per Visitor Day**

Expenditure Category	Survey Total	Per Visitor Day
Restaurant Meals	\$6,024	\$8.09
Lodging	\$6,021	\$8.08
Transportation	\$6,601	\$8.86
Fishing Related	\$2,036	\$2.73
Groceries	\$3,905	\$5.24
Other Local Retail	\$1,936	\$2.60
Total Local Spending	\$26,522	\$35.60

The IMPLAN Input-Output Model

In order to determine the total impact on county income and employment, direct visitor expenditures are entered into the appropriate sector of the IMPLAN model for the Plumas County economy. IMPLAN is an input-output model (I-O) that separates the economy into 509 industrial sectors, classifying each according to the primary product or service it provides. The transaction matrix is the model that estimates impacts. The transaction matrix contains the purchases and sales that occur among the various sectors. The column entries are the purchases made by a particular sector from all other sectors included in the model. The row elements are the industry destinations of the sector's sales. The I-O model permits assessment of the total impact of an initial change in income or expenditures. (MIG 2005)

The total impact is the sum of the direct, indirect, and induced impacts. The indirect impacts are the result of purchases (by the sectors directly affected) from local industries supplying inputs. The induced effects are due to the spending of additional income earned through the enhanced business activity generated by the direct impacts. The model output includes estimated impacts on output, income, employment and state and local taxes.

Estimated Local Impacts per 10,000 Visitor Days

Output, Income, Employment, and Revenue Impacts

Table 3 contains the IMPLAN model estimates of the local economic impacts for each 10,000 visitor days at Lake Davis. The estimates are generated from the direct spending by sector listed in Table 2. The effect on total output, or \$475,109, is equivalent to total expenditures or gross business sales within Plumas County. However, since the value of

output includes the value of inputs purchased from outside of the county, the output effect significantly overstates the impact on incomes within the county.⁴

The second row of Table 3 includes the direct, indirect, induced, and total income impacts. Income is defined as the sum of employee compensation, proprietor income, other property income, and indirect business taxes. The direct income effect is the result of visitor spending within the sectors designated in Table 2, while the indirect income impact is derived from purchases of inputs from suppliers within the county. The induced impact is the result of spending of the added income in the industries directly and indirectly affected by the visitor spending linked to the use of Lake Davis. The total income impact is simply the sum of the direct, indirect, and induced impacts, or \$278,422 per 10,000 visitor days.

The employment impacts are included in the last row of Table 3. Visitor spending by recreational users of Lake Davis generates 10.8 jobs per 10,000 visitor days. However, these are not full-time jobs, but rather they are based on the Department of Commerce definition of employment. Employee compensation per job averages \$12,945, far below the average full-time wage rate (\$35,840 in 2004) within the county.

Indirect business taxes are included in the income impact and total \$40,963 per 10,000 visitor days. Total state and local taxes, including income taxes and contributions to social insurance, are \$46,854, with sales taxes (\$19,322) and property taxes (\$13,080) providing the bulk of the revenues. The Plumas County share of revenues is approximately 25% of indirect business taxes, or \$10,241 per 10,000 visitor days.

Table 3: Impacts on Plumas County Output, Income, and Employment per 10,000 Visitor Days

<i>Impact Type</i>	<i>Direct</i>	<i>Indirect</i>	<i>Induced</i>	<i>Total</i>
Output	\$356,000	\$57,090	\$62,018	\$475,109
Income	\$208,139	\$31,707	\$38,576	\$278,422
Employee Compensation	\$109,457	\$14,742	\$15,609	\$139,807
Proprietor Income	\$44,056	\$3,528	\$3,482	\$51,066
Other Property Income	\$21,243	\$10,528	\$14,815	\$46,586
Indirect Business Taxes	\$33,383	\$2,910	\$4,670	\$40,963
Employment	9.10	0.80	0.90	10.80

Individual Industry Impacts

Table 4 contains the IMPLAN estimates of total income impacts by sector for the Plumas County economy. The table includes all sectors where income is affected by more than \$5,000 per 10,000 visitor days (\$0.50 per visitor day), and, the listed sectors receive 77%

⁴ Output can be interpreted as gross business sales and that term is used in place of output in the summary tables at the end of the report. Since the impact of greatest concern for local businesses and employees is income, the majority of the analysis is focused on the effect on local income.

of the total income impact within the local economy. The greatest income impacts are in those sectors receiving the most direct visitor spending. Owners and employees in hotels and motels (\$58,048); gasoline stations (\$55,167); food services and drinking places (\$39,880); and food and beverage stores (\$31,999) receive the greatest boost to income from visitor spending linked to Lake Davis recreational use.

Table 4: Total Income Impacts by Sector per 10,000 Visitor Days

IMPLAN Sector Number	Sector Description	Total Income Impact
405	Food and Beverage Stores	\$31,999
407	Gasoline Stations	\$55,167
409	Sporting Goods	\$12,659
431	Real Estate	\$8,245
479	Hotels and Motels	\$58,048
481	Food Services and Drinking Places	\$39,880
509	Owner Occupied Dwellings	\$9,604

Estimated Impacts for 2005

Income Impacts

The 2005 impact on the Plumas County economy of spending by recreational users of Lake Davis is calculated by multiplying the impacts per visitor day by the estimated visitor days for that year. Table 1 contains the various estimates for 2005 visitor days, and while the range is fairly wide (13,291 to 22,360), most of the estimates fall between 18,000 and 22,000 visitor days. Thus, the estimates contained here are based on a mid-range visitor day estimate of 20,000 with a variance of plus or minus 2,000.

Table 5 contains the estimated impacts of 2005 Lake Davis visitor spending on income of owners and employees of Plumas County businesses. The estimates include employee compensation, proprietor income, property income, and indirect business taxes. The income impact for the baseline estimate of 20,000 annual visitor days is \$556,844, with a possible income impact ranging from a low of \$501,160 (18,000 visitor days) to a high of \$612,528 (22,000 visitor days).

Table 5: Estimated 2005 Income Impacts on the Plumas County Economy

Impact Estimate	Direct	Indirect	Induced	Total
Income: Baseline	\$416,278	\$63,414	\$77,152	\$556,844
Employee Compensation	\$218,914	\$29,484	\$31,218	\$279,614
Proprietor Income	\$88,112	\$7,056	\$6,964	\$102,132
Other Property Income	\$42,486	\$21,056	\$29,630	\$93,172
Indirect Business Taxes	\$66,766	\$5,820	\$9,340	\$81,926
Income: High	\$457,906	\$69,755	\$84,867	\$612,528
Income: Low	\$374,650	\$57,073	\$69,437	\$501,160

Estimated income impacts by industry are similarly derived from the Table 4 estimates of the impacts per 10,000 visitor days. Table 6 contains the effects on industry income for all sectors receiving income of \$0.50 or more per visitor day from spending by Lake Davis recreational users. The largest effect on income is in the hotel and motel sector, with a baseline impact of \$116,096, and a range of estimates from a low of \$104,486 to a high of \$127,706. Other sectors experiencing a baseline income impact in excess of \$50,000 include gasoline stations (\$110,344), food services and drinking places (\$79,760), and food and beverage stores (\$63,998).

Table 6: Estimated 2005 Income Impacts by Industry

IMPLAN Sector Number	Sector Description	Baseline	High	Low
405	Food and Beverage Stores	\$63,998	\$70,398	\$57,598
407	Gasoline Stations	\$110,334	\$121,367	\$99,301
409	Sporting Goods	\$25,318	\$27,850	\$22,786
431	Real Estate	\$16,490	\$18,139	\$14,841
479	Hotels and Motels	\$116,096	\$127,706	\$104,486
481	Food Services and Drinking Places	\$79,760	\$87,736	\$71,784
509	Owner Occupied Dwellings	\$19,208	\$21,129	\$17,287

Other Impact Measures

Income is the best measure of the contribution of Lake Davis visitor spending to the Plumas County economy, yet other measures might be useful for some purposes. The impact on county output represents the effect on gross sales, but since it includes the value of industry purchases from businesses outside of the county, it is not an appropriate measure of the impact on local income. In addition, although effects on county employment are generated by the IMPLAN model, the jobs created or sustained are neither full-time, nor full-time equivalent jobs. County revenues are included in the income impact estimates as a portion of the entry for indirect business taxes.

Estimates for each of these additional impact measures are included in Table 7, with entries for the base case and the high and low estimates of total 2005 visitor days at Lake Davis. Visitor spending generates a total of \$950,212 in output (gross sales) within Plumas County, with the estimated impact ranging from a low of \$855,196 to a high of \$1,045,240. A total of between 19.4 and 23.8 jobs result from that spending, with a most likely estimate of 21.6 jobs. The Plumas County general fund, as is the case for most counties in the state, receives roughly 25% of indirect business taxes paid in connection with local economic activity, with most of the remainder going to the state. Thus estimated 2005 county revenue ranges from a low of \$18,433 to a high of \$22,530, with the estimate for baseline visitor days equal to \$20,482.

Table 7: Estimated 2005 Impacts on Output (Gross Sales), Employment, and Plumas County Revenue

Impact Type	Baseline	High	Low
Output	\$950,218	\$1,045,240	\$855,196
Employment	21.6	23.8	19.4
25% of Indirect Business Taxes	\$20,482	\$22,530	\$18,433

Study Results: Local Economic Impacts

Assumptions

Fishery Quality

Successful Eradication

With successful eradication of northern pike from Lake Davis it is assumed that the quality of the fishery will double within four years of project completion. The 2003 angler survey indicated a catch rate of 0.12 trout per hour, while in 2000 the catch rate was 0.28 trout per hour. Although the 2000 catch rate was more than double that of 2003, the average fish caught in 2003 was significantly larger. However, the assumptions that the catch rate will only double, and not until four years following completion of the eradication project, are relatively conservative. It is possible that from the anglers' prospective the quality will more than double and that improvement will be achieved in as little as two years after initial restocking. Earlier recovery of fishery quality increases the local economic benefits of both the successful and failed eradication cases.

Failed Eradication

If eradication is unsuccessful it is assumed that the fishery quality will follow a somewhat different path. Following attempted eradication it is assumed that the quality of the fishery will double within four years of project completion, however after that year the catch rate will decline until at the end of ten years it will have returned to current levels.

Visitor Response to Changes in Fishery Quality

The impact of changes in fishery quality on visitor days depends on the response of anglers to the catch rate and the timing of that response. The Lake Davis angler survey performed by the Center for Economic Development (CED) determined that a 100% increase in the catch rate will lead to a 63.2% increase in visitor days. This is very close to the 64.5% response rate from the environmental economics literature and the 63.2% figure from the survey is used in the economic impact analysis performed for each of the pike eradication and management scenarios. It is also assumed that angler visitor days are determined by the previous year's catch rate. Thus the peak for visitor days will always lag the peak for the catch rate by one year. In addition the angler response rate of 63.2% is used for both an increase and a decrease in fishery quality. (Loomis 2005)

Scenario 1: The Preferred Alternative

Table 8 includes the impacts on Plumas County income of both successful and failed eradication using the method proposed under the preferred alternative. In both cases the lake is unavailable for one year and thus for that year visitor days are assumed to be zero. In the second year visitor days return to their pretreatment levels, growing at a 13% annual rate until they reach a peak at 32,600 in year 6. The actual annual growth rate for visitor days is higher than 13% and continues beyond year 6 due to growth in population in those areas from which visitors are drawn.⁵

The income impacts are included for a 22 year period in order to extend the analysis for two treatment cycles under the failed treatment scenarios.⁶ The total contribution to Plumas County income for the 22 years is \$20.42 million for the successful eradication case, and, \$15.75 million and \$13.32 million for the two failed eradication cases.⁷ For all of the scenarios the failed eradication cases are delineated according whether the attempt is repeated at 11-year intervals (failed/repeat) or done just once (failed/once). All totals are in constant 2005 dollars. Discounting at a 3% real discount rate results in a total net present value for the income impacts of \$14.20 million, and, \$11.12 million and \$9.75 million for the successful and the two failed eradication cases, respectively.⁸

⁵ The annual rate of growth in visitor days is the weighted average of the projected rates of population growth for California, Plumas County, and Washoe County Nevada. The weights are from the California Department of Water Resources (DWR 2005) survey of angler origin. The projected rates of population growth are from the California Department of Finance (DOF 2005) and the Nevada State Demographer (NSD 2005). Based on this approach regional population growth is projected to increase visitor days at Lake Davis by 1.03% annually.

⁶ There are two failed eradication cases: one assuming eradication is a periodic event repeated every 10 years (11 years including the treatment period for the preferred alternative) and another where eradication fails, but is not attempted again within the 22 year period of the analysis. By including the multiple treatment case, the California Department of Fish and Game is not implying that it contemplates periodic treatments on an 11 year cycle. Obviously the intention is for the primary treatment to be successful and both the failed eradication cases are included only for purposes of comparison with scenario 4, the no action alternative.

⁷ The income impacts are derived directly from the visitor day estimates. In order for the improvements in fishery quality to generate an increase in visitor days, it is necessary that potential visitors become aware of the changes in catch rate, and for that to occur, it is necessary that they choose Lake Davis as a fishing destination. For that reason it might be argued that there is a degree of uncertainty in the local income impact estimates. It is true that the level of uncertainty is greater than the 100% chance that the lake will be unavailable during the treatment period, however, anglers did return to the lake after the 1998 treatment and are likely to do so again.

⁸ For each of the scenarios analyzed the 22 year totals are presented in both undiscounted and discounted form. The discounted totals place greater importance on income received in earlier years, implicitly recognizing the time value of money. A 3% real discount rate is typically used for decisions involving environmental changes and other public goods and is equal to the real interest rate on relatively risk free investments. The real interest rate is the difference between the nominal interest rate and the rate of inflation.

Table 8: Visitor Days and Impact on Plumas County Income for the Preferred Alternative: Successful and Failed Eradication Efforts

<i>Visitor Day Estimates</i>				<i>Income Impacts</i>		
<i>With Population Growth</i>				<i>With Population Growth</i>		
Years	Successful	Failed/Repeat	Failed/Once	Successful	Failed/Repeat	Failed/Once
1	0	0	0	\$0	\$0	\$0
2	20,206	20,206	20,206	\$562,535	\$562,535	\$562,535
3	23,066	23,066	23,066	\$642,165	\$642,165	\$642,165
4	26,331	26,331	26,331	\$733,068	\$733,068	\$733,068
5	30,059	30,059	30,059	\$836,838	\$836,838	\$836,838
6	34,314	34,314	34,314	\$955,297	\$955,297	\$955,297
7	34,667	31,440	31,440	\$965,137	\$875,289	\$875,289
8	35,024	28,807	28,807	\$975,078	\$801,981	\$801,981
9	35,385	26,394	26,394	\$985,121	\$734,813	\$734,813
10	35,750	24,184	24,184	\$995,268	\$673,271	\$673,271
11	36,118	22,158	22,158	\$1,005,519	\$616,883	\$616,883
12	36,490	0	21,632	\$1,015,876	\$0	\$602,237
13	36,866	22,617	21,118	\$1,026,340	\$629,656	\$587,938
14	37,245	25,819	20,617	\$1,036,911	\$718,788	\$573,979
15	37,629	29,473	20,128	\$1,047,591	\$820,537	\$560,351
16	38,017	33,645	19,650	\$1,058,381	\$936,689	\$547,047
17	38,408	38,408	19,183	\$1,069,283	\$1,069,283	\$534,058
18	38,804	35,191	18,728	\$1,080,296	\$979,728	\$521,378
19	39,203	32,244	18,283	\$1,091,423	\$897,673	\$509,000
20	39,607	29,543	17,849	\$1,102,665	\$822,491	\$496,915
21	40,015	27,069	17,425	\$1,114,022	\$753,605	\$485,117
22	40,427	24,802	17,011	\$1,125,497	\$690,489	\$473,599
Total				\$20,424,311	\$15,751,078	\$13,323,758
Net Present Value (3% real discount rate)				\$14,197,167	\$11,115,286	\$9,751,234

Scenario 2

Scenario 2 involves drawing the lake down to its minimum capacity, and as a result, using this eradication method involves loss of recreational use of the lake for a period of three years. Table 9 includes the impacts on Plumas County income of both successful and failed eradication using the method proposed under scenario 2. In both cases the lake is unavailable for three years and thus visitor days are assumed to be zero for those years. In the fifth year visitor days return to their pretreatment levels, growing at a 13% annual rate thereafter until they reach a peak of 32,600 in year 8. As with the preferred alternative the actual annual growth rate for visitor days is higher than 13% and continues beyond year 8 as population grows within the area served by Lake Davis.

As in the case of the preferred alternative, the income impacts are included for a 22 year period in order to extend the analysis for two treatment cycles under the failed treatment scenario, but also considered is the option of treating the lake just once with this method. The total contribution to Plumas County income for the 22 years is lower than for

scenario 1 at \$18.56 million for the successful eradication case, and, \$15.13 million and \$13.43 million for the failed eradication cases, with all in totals in constant 2005 dollars. Discounting at a 3% real discount rate results in a total net present value for the income impacts of \$12.52 million, and, \$10.20 million and \$9.39 million for the successful and two failed eradication cases, respectively.

Table 9: Visitor Days and Impact on Plumas County Income for Scenario 2: Successful and Failed Eradication Efforts

<i>Visitor Day Estimates</i>				<i>Income Impacts</i>		
<i>With Population Growth</i>				<i>With Population Growth</i>		
Years	Successful	Failed/Repeat	Failed/Once	Successful	Failed/Repeat	Failed/Once
1	0	0	0	\$0	\$0	\$0
2	0	0	0	\$0	\$0	\$0
3	0	0	0	\$0	\$0	\$0
4	20,624	20,624	20,624	\$574,183	\$574,183	\$574,183
5	23,544	23,544	23,544	\$655,462	\$655,462	\$655,462
6	26,877	26,877	26,877	\$748,247	\$748,247	\$748,247
7	30,681	30,681	30,681	\$854,166	\$854,166	\$854,166
8	35,024	35,024	35,024	\$975,078	\$975,078	\$975,078
9	35,385	32,091	32,091	\$985,121	\$893,413	\$893,413
10	35,750	29,403	29,403	\$995,268	\$818,587	\$818,587
11	36,118	26,941	26,941	\$1,005,519	\$750,029	\$750,029
12	36,490	0	26,301	\$1,015,876	\$0	\$732,221
13	36,866	0	25,677	\$1,026,340	\$0	\$714,836
14	37,245	0	25,067	\$1,036,911	\$0	\$697,864
15	37,629	23,085	24,472	\$1,047,591	\$642,694	\$681,295
16	38,017	26,353	23,891	\$1,058,381	\$733,671	\$665,119
17	38,408	30,084	23,324	\$1,069,283	\$837,527	\$649,328
18	38,804	34,342	22,770	\$1,080,296	\$956,084	\$633,911
19	39,203	39,203	22,229	\$1,091,423	\$1,091,423	\$618,860
20	39,607	35,920	21,701	\$1,102,665	\$1,000,014	\$604,167
21	40,015	32,912	21,186	\$1,114,022	\$916,260	\$589,822
22	40,427	30,155	20,683	\$1,125,497	\$839,521	\$575,818
Total				\$18,561,328	\$13,286,358	\$13,432,404
Net Present Value (3% real discount rate)				\$12,517,997	\$9,046,943	\$9,385,830

Scenario 3

Scenario 3 involves drawing the lake down to 48,000 acre feet, and as a result, using this eradication method involves minimal loss of recreational use of the lake. That is because all boat ramps will continue to be usable, and although the lake will not be stocked during year one of this eradication option, some fishing activity will likely continue. Table 10 includes the impacts on Plumas County income of both successful and failed eradication using this method and assuming lake use will be affected for just 50% of year 1. In this case visitor days total 10,000 for year 1 and then return to the current estimated use of 20,000 (plus the effect of population growth) in year 2. As with the other eradication options the improvement in catch rate causes visitor days grow at 13% annually until they

reach a peak in year 6 (five years after completion of treatment), while actual use grows at a higher rate, reflecting population growth in the area served by Lake Davis.

The total contribution to Plumas County income for the 22 years is slightly higher than for scenarios 1 and 2 at \$20.70 million for the successful eradication case, and, \$16.34 million and \$13.60 million for the failed eradication cases, all in constant 2005 dollars. Discounting at a 3% real discount rate results in a total net present value for the income impacts of \$14.47 million, and, \$11.60 million and \$10.02 million for the successful and failed eradication cases, respectively.

Table 10: Visitor Days and Impact on Plumas County Income for Scenario 3: Successful and Failed Eradication Efforts

<i>Visitor Day Estimates</i>				<i>Income Impacts</i>		
<i>With Population Growth</i>				<i>With Population Growth</i>		
Years	Successful	Failed/Repeat	Failed/Once	Successful	Failed/Repeat	Failed/Once
1	10,000	10,000	10,000	\$278,400	\$278,400	\$278,400
2	20,206	20,206	20,206	\$562,535	\$562,535	\$562,535
3	23,066	23,066	23,066	\$642,165	\$642,165	\$642,165
4	26,331	26,331	26,331	\$733,068	\$733,068	\$733,068
5	30,059	30,059	30,059	\$836,838	\$836,838	\$836,838
6	34,314	34,314	34,314	\$955,297	\$955,297	\$955,297
7	34,667	31,440	31,440	\$965,137	\$875,289	\$875,289
8	35,024	28,807	28,807	\$975,078	\$801,981	\$801,981
9	35,385	26,394	26,394	\$985,121	\$734,813	\$734,813
10	35,750	24,184	24,184	\$995,268	\$673,271	\$673,271
11	36,118	22,158	22,158	\$1,005,519	\$616,883	\$616,883
12	36,490	11,193	21,632	\$1,015,876	\$311,618	\$602,237
13	36,866	22,617	21,118	\$1,026,340	\$629,656	\$587,938
14	37,245	25,819	20,617	\$1,036,911	\$718,788	\$573,979
15	37,629	29,473	20,128	\$1,047,591	\$820,537	\$560,351
16	38,017	33,645	19,650	\$1,058,381	\$936,689	\$547,047
17	38,408	38,408	19,183	\$1,069,283	\$1,069,283	\$534,058
18	38,804	35,191	18,728	\$1,080,296	\$979,728	\$521,378
19	39,203	32,244	18,283	\$1,091,423	\$897,673	\$509,000
20	39,607	29,543	17,849	\$1,102,665	\$822,491	\$496,915
21	40,015	27,069	17,425	\$1,114,022	\$753,605	\$485,117
22	40,427	24,802	17,011	\$1,125,497	\$690,489	\$473,599
Total				\$20,702,711	\$16,341,096	\$13,602,158
Net Present Value (3% real discount rate)				\$14,467,459	\$11,604,140	\$10,021,525

Scenario 4

Scenario 4, the no action alternative, yields the smallest contribution to Plumas county income. Although there are no years for which visitor days are zero, the postulated declining catch rate attracts fewer visitors each year through year 11. After year 10 it is assumed that the ongoing pike management program successfully halts the decline in the catch rate, but not until the quality of the fishery has declined by 50% from current levels.

As is the case for all of the eradication scenarios, population growth in the areas from which Lake Davis visitors are drawn leads to an increase in annual visitor days, in this case after the minimum is reached in year 11.

The contribution to Plumas County income of spending by Lake Davis visitors is lower than for any of the eradication scenarios. The total for the 22 years is \$10.35 million in 2005 dollars, while the net present value at a 3% real discount rate is \$7.57 million. Even if improved methods of managing northern pike were capable of maintaining the current trout catch rate, all of the pike eradication scenarios result in more income for Plumas County. With base year visitor days at 20,000, and with population growth resulting in an annual increase in visitor days of 1.03%, the total contribution to local income for the 22 year period is \$13.67 million, just 67% of the amount generated for the same period using the preferred alternative for pike eradication.

Table 11: Visitor Days and Impact on Plumas County Income for Scenario 4: No Action Alternative

Years	Visitor Day Estimates		Income Impacts with Population Growth
	Without Population Growth	With Population Growth	
1	20,000	20,000	\$556,800
2	19,326	19,525	\$543,580
3	18,675	19,062	\$530,674
4	18,046	18,609	\$518,075
5	17,438	18,167	\$505,774
6	16,850	17,736	\$493,766
7	16,167	17,192	\$478,625
8	15,511	16,665	\$463,949
9	14,882	16,154	\$449,722
10	14,279	15,658	\$435,932
11	13,700	15,178	\$422,565
12	13,700	15,335	\$426,917
13	13,700	15,493	\$431,314
14	13,700	15,652	\$435,757
15	13,700	15,813	\$440,245
16	13,700	15,976	\$444,780
17	13,700	16,141	\$449,361
18	13,700	16,307	\$453,989
19	13,700	16,475	\$458,666
20	13,700	16,645	\$463,390
21	13,700	16,816	\$468,163
22	13,700	16,989	\$472,985
Total			\$10,345,029
Net Present Value (3% real discount rate)			\$7,574,598

Economic Impacts by Pike Management Scenario

Successful Eradication vs. Ongoing Pike Management

Table 12 includes the impacts on annual sales, income, employment, and county revenues for each of the eradication scenarios (scenarios 1-3) and the ongoing pike management scenario (scenario 4). It is clear that from the perspective of the Plumas County economy any of the eradication options, if successful, is preferable to the current pike management option. For the 22 year period covered by the analysis average annual gross sales for Plumas County businesses are higher by \$781,802 for the preferred option (scenario 1) relative to ongoing pike management. Average annual Plumas County income, employment, and county revenue are also higher by \$458,109, 18 jobs, and \$16,851, respectively.

The economic advantage of pike eradication is somewhat greater for scenario 3 with average annual gross sales for Plumas county businesses higher than for the pike management option by \$803,396 and exceeding that for the preferred option by \$21,594. Income, employment, and county revenues are also somewhat higher than for the preferred option. However, the important result is that, because of the long term impact on the quality of the Lake Davis fishery, successful eradication by any of the means under consideration is preferable to the current strategy of pike management alone.

Table 12: Impacts on Plumas County Output (Gross Sales), Income, Employment, and County Revenue: Successful Eradication Scenarios (Scenarios 1-3) and Ongoing Pike Management (Scenario 4)

Average Annual Impact on Plumas County:	Scenario Number			
	1	2	3	4
Sales	\$1,584,216	\$1,439,713	\$1,605,810	\$802,414
Income	\$928,378	\$843,697	\$941,032	\$470,229
Employment	36	33	37	18
Revenue	\$34,147	\$31,032	\$34,612	\$17,296

Failed Eradication vs. Ongoing Pike Management

While the results included in Table 12 indicate that successful eradication of pike from Lake Davis would have clear economic advantages for Plumas County, the possibility that any eradication effort might fail must also be considered. In that case pike eradication would be a periodic event (every 11 years) or a one-time effort, with current management techniques employed in the interim. Table 13 includes the impact on Plumas County gross sales, income, employment, and county revenues for each of the failed repeat eradication scenarios. Table 14 includes the economic impacts for a one-time failed eradication effort. For purposes of comparison the management option is also included under scenario 4 in both Tables 13 and 14.

The results clearly indicate that repeating a failed eradication effort is preferable to the current strategy of pike management alone. Using the preferred alternative, average annual gross sales for Plumas County businesses are \$419,321 higher than for the management option. Average annual Plumas County income, employment, and county revenue are also higher by \$245,730, 10 jobs, and \$9,038, respectively. As in the case of successful eradication, the economic advantages of scenario 3 over ongoing pike management are somewhat greater. With this scenario estimated annual gross sales of Plumas County businesses exceed those associated with scenario 4 by \$465,086 and are \$45,765 higher than for the preferred alternative. Income, employment, and county revenues are also somewhat higher than for the preferred option.⁹

Table 13: Impacts on Plumas County Output (Gross Sales), Income, Employment, and County Revenue: Repeat Failed Eradication Scenarios (Scenarios 1-3) and Ongoing Pike Management (Scenario 4)

Average Annual Impact on Plumas County:	Scenario Number			
	1	2	3	4
Sales	\$1,221,736	\$1,173,739	\$1,267,501	\$802,414
Income	\$715,958	\$687,831	\$742,777	\$470,229
Employment	28	27	29	18
Revenue	\$26,334	\$25,299	\$27,320	\$17,296

With the one-time failed eradication cases included in Table 14 there is very little difference in the annual impacts on sales, local income, employment, and local government revenue. Average annual impacts range from \$1,033,460 to \$1,055,054 for gross sales; from \$605,625 to \$618,280 for income; from 23 to 24 jobs; and from \$22,276 to \$22,471 for local government revenue. As in the repeat failed eradication cases, the average annual impacts exceed those of scenario 4, using ongoing pike management alone.

⁹ It might be argued that the advantages of a failed eradication attempt are overstated due to the assumptions regarding the period of time that the quality of the fishery can be sustained. For each of the scenarios it is assumed that the quality of the fishery improves for the first four years following the eradication project. Yet, there is clear evidence that the catch rate for Lake Davis trout had declined beginning three years after the restocking that followed the 1997-98 effort. However, the assumption of an additional year of sustained growth is reasonable since it is likely that this time around, if pike reappear in the lake, DFG will immediately implement those management techniques that have proven to be most effective. The assumption of an additional year of sustained fishery quality is simply a reflection of the value of previous management experience.

Table 14: Impacts on Plumas County Output (Gross Sales), Income, Employment, and County Revenue: One-Time Failed Eradication Scenarios (Scenarios 1-3) and Ongoing Pike Management (Scenario 4)

Average Annual Impact on Plumas County:	Scenario Number			
	1	2	3	4
Sales	\$1,033,460	\$1,041,887	\$1,055,054	\$802,414
Income	\$605,625	\$610,564	\$618,280	\$470,229
Employment	23	24	24	18
Revenue	\$22,276	\$22,457	\$22,741	\$17,296

Conclusions

Ranking the alternative methods of dealing with the northern pike problem in Lake Davis is relatively straightforward when the sole criterion is the economic impact on the Plumas County economy. The conclusion based on the analysis contained within this report is that eradication is preferable to the current management program. Even a failed attempt at eradication (repeat or one-time) yields a better economic outcome for Plumas County. Among the alternative methods of eradication proposed scenario 3 yields the greatest local economic benefits, although scenario 1, the preferred alternative, is a close second. Both are preferable, on the basis of economic impact (in all but the one-time failed eradication case), to scenario 2 since the latter implies the loss of the recreational use of the lake for a full three years.

The choice between scenarios 1 and 3 is a difficult one and one that cannot be made on the basis of economic impact alone. For the successful eradication case there is a difference of just under \$22,000 in the annual effect on gross sales and less than a \$13,000 difference in the impact on annual local income. While the differences are greater for the repeat failed eradication case, the disparity is insignificant relative to the gap between the successful and failed eradication cases. If eradication were to be unsuccessful, and were to be repeated periodically (every 11 years in this case), under scenario 3, annual business sales would average \$338,300 less than for the successful case. In addition, annual income would be lower by an average of \$198,300. The disparity between impacts on gross business sales and local income are likewise significant for scenario 1, the preferred alternative. Under this option a failed repeat eradication effort would reduce average annual gross sales and local income by \$362,500 and \$212,400, respectively.

On the basis of economic impact on the Plumas County economy, a pike eradication effort by any of the proposed methods is preferable to continuing the current pike management program alone. And, since the differences in the impacts among the alternative scenarios are insignificant (at least for scenarios 1 and 3) relative to the local economic cost of a failed eradication attempt, the choice of an eradication method should be made on the basis of which one has the greatest probability of success.

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Appendix A

Resource Valuation

As the previous economic impact analysis has shown, improving the quality of the Lake Davis fishery, by eradicating the Northern Pike, has the potential to increase the local economic benefits of Plumas County. By improving the quality of the fishery we can expect an increase in visitation and expenditures which results in an increase in income to local businesses such as restaurants, gas station owners, motel owners, and other retail businesses. The local community in-turn also benefits as the increase in economic activity also leads to increases in employment, and local government tax revenue. However, expenditures by visitors which contribute income to the local community are costs rather than benefits to the local visitor.

In conventional economics it is generally accepted that measures of economic value should be based on the preferences of individuals. More specifically, the economic value of a resource is measured by the maximum willingness to pay to obtain a good or service. Dollars are a universally accepted measure of economic value because the amount that people are willing to pay for something reflects how much of all other for-sale goods and services they are willing to give up to get it. Under most circumstances individuals must pay an actual price or incur expenses to obtain the good. So, to determine the value that visitors place on the Lake Davis resource, economists estimate consumer surplus or net willingness to pay, which is defined as the difference between the maximum an individual is willing to pay to fish at Lake Davis versus the expenditures paid to fish Lake Davis. For example, if a visitor is willing to pay up to \$90 to fish at Lake Davis and incurred \$50 in expenses while traveling to and fishing Lake Davis, then the net economic value that the visitor places on Lake is \$40. By taking the summation of the consumer surplus or net willingness to pay by all visitors to Lake Davis, we can estimate the value that visitors place on the Lake Davis resource. With improvement in the quality of the fishery, we would expect an increase in visitation and willingness to pay, resulting in an increase in the value of the Lake Davis resource.

Estimation of the value of Lake Davis is accomplished using a travel cost model. The use of travel cost to estimate the demand for recreational sites was first suggested by H. Hotelling in the late 1940's. The model was further developed by Knetsch and Clawson in the 1950's and 1960's and has since gained broad acceptance among resource economists. The literature in resource and environmental economics contains numerous studies using variations on the travel cost model.

This family of approaches to valuing a resource is based on the idea that the cost of getting to a recreational site is a measure of the value individuals place on its use. A demand curve is generated from the various travel costs and the associated number of trips. It is fundamental to economic theory that the higher the price of a good or service the smaller the quantity demanded. In the vernacular of the travel cost model this means that as travel cost increases, as it does with distance from the site, the smaller the number

of trips made annually. The total value of the resource is estimated as the area under the generated demand curve but above the average travel cost for all surveyed users.

The individual travel cost method was chosen for the study utilizing surveys to collect data specific to each individual visitor's travel distance and demographic information. Individuals were asked about the distance traveled, travel time, the expenses they incurred traveling, the length of their trip, how much time they spent at the site, the quality of their recreation experience at the site, their perception of the site's environmental quality, characteristics of the site, and residence (used to determine whether they reside in a rural or urban area).

Data Sources

Surveys and visitor counts were conducted at Lake Davis on 13 days between September 17, 2005 and October 21, 2005 for a total of 162.5 hours. Over that time interval 195 parties were observed representing 384 individual visitors. Of those 195 parties, 151 filled out the detailed survey form (see Appendix B for the actual form used). Interviews were conducted at four boat launch points including Honker Cove, Mallard Cove, Eagle Point, and Camp 5.

There was an average of 1.8 individuals per interviewed party with 97.5% of those interviewed visiting from outside of Plumas County. The duration of the average visit was 2.66 days, while the average visiting party makes 2.67 trips to Lake Davis annually. Most visitors (90.68%) listed the primary purpose of their visit as fishing, with 6.21% visiting friends and the remainder traveling to the area for business or other recreation. Just fewer than 70% of surveyed visitors stayed in the local area, with 38.1% of those staying locally utilizing campground facilities, 22.9% staying in hotels or motels, 16.2% staying with friends, and the remainder listing "other", primarily second homes.

Wage data by county is from the 2000 Census (USCB 2005). Conversion to hourly wage rates is accomplished by dividing by 1948, the average annual hours worked (USCB 2005). Driving distance is calculated from the origin ZIP codes to the destination ZIP codes and cost per mile was obtained from the AAA website.

The Model and Variables Included

The travel cost model specifies a relationship between the number of annual visitor days per travel party from a particular origin to a particular destination and the cost of the trip (travel cost). There are also three dummy variables included, one specifying whether the county of origin is urban or rural, and two that determine whether the visitor is staying in a cabin or second home, staying with friends, or staying somewhere other than at a campsite or a motel/hotel.

Travel cost includes three elements. It is defined as the sum of the direct cost of the trip, the opportunity cost in terms of lost wages for the duration of the trip, and the on-site

preparation time for boat launching or getting to a site for fishing. Each of these elements of travel cost is estimated in the conventional manner. Direct travel cost is equal to the cost per mile (56.2 cents) times the number of miles required to make the round trip to the site. Opportunity cost is calculated as 30 percent of the average hourly wage rate for the county of origin times the number of hours of travel time. The cost of preparation time is computed in the same manner, and for all sites is equal to one-half hour times 30 percent of the hourly wage rate. Where there is more than one individual in the fishing party it is assumed that direct travel cost is shared equally among the members.

Whether an area is urban or rural is an important determinant of resident participation in fishing activity. Compared to residents of rural areas, there is a lower probability of an urban resident being a frequent angler (USFWS 1996). The difficulty is in distinguishing rural from urban areas. The definition adopted here is that a county with a population over 750,000 and where 30% or more of the county population lives in a city of more than 100,000 residents is urban. If the ZIP code reported on the survey entry is in an urban county the observation is assigned a zero, while if it is in a rural county a value of one is assigned.

Where a visitor chose to stay was also accounted for in the analysis. Cabin is equal to one if a visitor is staying in a cabin or second home, while if a visitor stays elsewhere a value of zero is assigned. Friend is equal to one if a visitor is staying with friends, while if a visitor stays elsewhere a value of zero is assigned. The coefficient for the cabin and friend variables are expected to be positive because we believe that a visitor is likely to stay longer or visit more often if friends or cabin are present.

Estimated Equation

The following equation was estimated in log-log form using ordinary least squares.

$$\text{Ln}(\text{Visitordays}) = a + b \text{Ln}(\text{TC}_{ij}) + c \text{Cabin}_j + d \text{Friends}_j + e \text{Rural}_i$$

Where, for each of the 160 observations representing 6479 visitor days:

$\text{Ln}(\text{Visitordays}_{ij})$ is the dependent variable. For each observation it represents the number of visitor days by a traveling party from county of origin, i to destination, j (Lake Davis). It is equal to the number of individuals in the fishing party multiplied by the length of stay multiplied by the number of annual visits.

$$\begin{aligned} \text{TC}_{ij} = & \text{travel cost from ZIP code origin, } i \text{ to Lake Davis (} j \text{) and} = \\ & (\$0.562 * \text{round trip distance in miles}) / \text{number in fishing party} \\ & + 0.3 * \text{hourly wage rate} * \text{round trip travel time} \\ & + 0.3 * \text{hourly wage rate} * 0.5 \text{ hours} \end{aligned}$$

$\text{Cabin}_j = 0$ or 1 and is a dummy variable indicating whether a visitor is utilizing a cabin or second home (1) or staying someplace else (0).

Friend_j = 0 or 1 and is a dummy variable indicating whether a visitor is staying with a friend (1) or staying someplace else (0).

Rural_i = 0 or 1 and is a dummy variable defining the county of origin as rural (1) or urban (0)

a – e are the coefficients to be estimated

Coefficient Estimates

The estimated equation is:

$$\text{Ln(Visitordays)} = 3.910331 - .4393893\text{Ln(TC)} + 1.405761\text{Cabin} + .6317431\text{Friend} + .3197781\text{Rural}$$

Table A1: Regression Coefficients, Standard Errors, and T-Values¹⁰

<i>Variable</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	3.910331	.5487824	7.13*
Ln(TC)	-.4393893	.1016697	-4.32*
Cabin	1.405761	.2810408	5.00*
Friend	.6317431	.3412577	1.85**
Rural	.3197781	.2723119	1.17

Table A1 contains the coefficients, their respective standard errors and t-values. Table A2 includes the adjusted R-square and F-value for the regression.

Table A2: Regression Statistics: Adjusted R-Square and F-Value

<i>Regression Statistics</i>	
Observations	160
R Square	0.2608
Adjusted R Square	0.2417
F(4, 155)	13.67

Table A1 shows that there is a relationship, significant at the 1% confidence level, between the visitor day variable and the variables for travel cost and staying in a cabin or second home. As expected, visitor days and travel cost are negatively related, while visitor days and cabin or second home ownership are positively related. Staying with friends is significant and positively related to visitor days at the 10% level. Whether the county of origin was designated as rural or urban was not found to be significantly related to visitor days at standard levels.

¹⁰ * Indicates statistically significant variables at the 1% level or better.

** Indicates statistically significant variables at the 10% level or better.

The 2005 Value of the Lake Davis Fishery Resource to Freshwater Anglers

Using the statistical results from the model and the visitor day use from the U.S. Forest Service (USFS), California Department of Fish and Game (DFG), and the Center for Economic Development (CED) allows estimation of the current (2005) value of the recreation opportunities at Lake Davis. To calculate net WTP on consumer surplus per visitor day for the log-log functional form, we utilize the approximation developed by Graham-Tomasi, Adamowics and Fletcher (1990), if $b > -1$:

$$CS/Q = (1/(b+1)) * (\max(TC)\text{Min}(Q) - TC*Q)/Q$$

The visitors net WTP per day from the travel cost model is \$67. Given that nearly 91% of visitors indicate that the primary purpose of visiting Lake Davis is fishing, the value of \$67 per visitor day likely captures the value fisherman place on Lake Davis trout. The estimate of \$67 per visitor day is consistent with the estimated value of other trout fisheries cited in the environmental and resource economics literature. For example, Loomis (2005) has determined that trout fisheries in the intermountain west to be roughly equal to \$50 per day. The 2005 net annual economic value of Lake Davis resource to visitors is the product of the annual number of visitor days and consumer surplus per visit. Since the range of visitor days derived by the USFS, DFG, and CED varies from 13,291 to 22,360, the estimated net economic value falls somewhere between \$890, 497 and \$1,498,120, with a probable value of \$1,340,000 (based on 20,000 visitor days).

The Impacts on the Value of the Lake Davis Fishery Resource for the Preferred Alternative and No Action Alternative Scenarios

Table A3 includes the impacts on the net resource value of Lake Davis of both successful and failed eradication using the method under the preferred alternative, scenario 1, and the no action alternative, scenario four. We once again assume that visitors respond to changes in fishery quality, with a 100% increase in catch rate leading to a 63.2% increase in visitor days. It is also assumed that angler visitor days will always lag the peak catch rate by one year. For simplicity, we also assume that net WTP per visitor day, \$67, does not vary as fishery quality varies.¹¹

Table A3: The Value of the Lake Davis Fishery Resource under Scenarios 1 and 4

<i>Visitor Days with Population Growth</i>		<i>Resource Value</i>	
<i>Scenario 4:</i>	<i>Scenario 1:</i>	<i>Scenario 1: Eradication</i>	<i>Scenario 4:</i>

¹¹ It should be noted that there is a vast literature that indicates that WTP estimates are positively related to improvement in catch rates (see Loomis (2005) Kerkvliet and Nowell(2000)). Thus, the estimates of economic value of the Lake Davis Resource will be understated in scenarios in which catch rate improves and overstated in scenarios in which catch rate worsens.

Management Only		Eradication				Management Only
Years		Successful	Failed	Successful	Failed	
1	20,000	0	0	\$0	\$0	\$1,340,000
2	19,525	20,206	20,206	\$1,353,802	\$1,353,802	\$1,308,185
3	19,062	23,066	23,066	\$1,545,441	\$1,545,441	\$1,277,125
4	18,609	26,331	26,331	\$1,764,207	\$1,764,207	\$1,246,803
5	18,167	30,059	30,059	\$2,013,942	\$2,013,942	\$1,217,201
6	17,736	34,314	34,314	\$2,299,028	\$2,299,028	\$1,188,301
7	17,192	34,667	31,440	\$2,322,707	\$2,106,478	\$1,151,863
8	16,665	35,024	28,807	\$2,346,631	\$1,930,056	\$1,116,543
9	16,154	35,385	26,394	\$2,370,802	\$1,768,409	\$1,082,306
10	15,658	35,750	24,184	\$2,395,221	\$1,620,300	\$1,049,118
11	15,178	36,118	22,158	\$2,419,892	\$1,484,596	\$1,016,948
12	15,335	36,490	0	\$2,444,817	\$0	\$1,027,423
13	15,493	36,866	22,617	\$2,469,998	\$1,515,336	\$1,038,005
14	15,652	37,245	25,819	\$2,495,439	\$1,729,841	\$1,048,697
15	15,813	37,629	29,473	\$2,521,142	\$1,974,711	\$1,059,498
16	15,976	38,017	33,645	\$2,547,110	\$2,254,243	\$1,070,411
17	16,141	38,408	38,408	\$2,573,345	\$2,573,345	\$1,081,436
18	16,307	38,804	35,191	\$2,599,851	\$2,357,821	\$1,092,575
19	16,475	39,203	32,244	\$2,626,629	\$2,160,348	\$1,103,829
20	16,645	39,607	29,543	\$2,653,683	\$1,979,414	\$1,115,198
21	16,816	40,015	27,069	\$2,681,016	\$1,813,633	\$1,126,685
22	16,989	40,427	24,802	\$2,708,631	\$1,661,737	\$1,138,290
		Total		\$49,153,335	\$37,906,689	\$24,896,441
Net Present Value (3% Real Discount Rate)				\$34,167,033	\$26,750,148	\$18,229,098

Scenario 1: The Preferred Alternative

Once again, whether the treatment method is successful or the fails the lake is unavailable for one year and thus for that year visitor days are assumed to be zero. In the second year visitor days return to their pretreatment levels, growing at a 13% annual rate (baseline values) until they reach a peak at 32,600 in year 6. The actual annual growth rate for visitor days is higher than 13% and continues beyond year 6 due to growth in population in those areas from which visitors are drawn.

The scenario 1 impacts on the value of the Lake Davis fishery resource are included for a 22 year period in order to extend the analysis for two treatment cycles under the failed treatment scenario. The total net economic value of the Lake Davis resource for the 22 years is \$49.15 million for the successful eradication case and \$37.91 million for the failed eradication case. Discounting at a 3% real discount rate results in a total net present value for the net economic value of the Lake Davis resource of \$34.17 million and \$26.75 million for the successful and failed eradication cases, respectively

Scenario 4: No Action Alternative

Under scenario 4 there are no years for which visitor days are zero, however the postulated declining catch rate attracts fewer visitors each year through year 11. After year 10 it is assumed that the ongoing pike management program successfully halts the decline in the catch rate, but not until the quality of the fishery has declined by 50% from current levels. As is the case for all of the eradication scenarios, population growth in the areas from which Lake Davis visitors are drawn leads to an increase in annual visitor days, in this case after the minimum is reached in year 11.

The total net economic value of the Lake Davis resource with scenario 4 for the 22 years is \$24.90 million in constant 2005 dollars. Discounting at a 3% real discount rate results in a total net present value for the net economic value of the Lake Davis resource of \$18.23. Scenario 4, the no action alternative, clearly yields the smaller value to the Lake Davis resource compared to either a successful or failed attempt of eradication under scenario 1.

Appendix B

Center for Economic Development, California State University Chico
Mailing Address: CSU, Chico, Chico, CA 95929-0765, Phone: 898-4598

The Center for Economic Development at California State University, Chico, is conducting an economic impact study, funded by the California Department of Fish and Game, of Lake Davis recreational activities on the Plumas County economy. All responses to questions will be kept strictly confidential.

1. Where is your place of residence?

City, State, ZIP _____

2. What is the primary purpose of your visit to this area?

- a) Business _____
- b) Tourism or visiting friends _____
- c) Fishing _____
- d) Other recreation _____

3. Approximate travel time (one-way)? _____

4. Are you staying locally? Yes _____ No _____

5. Length of stay (days)? _____

6. Annual number of trips to Lake Davis? _____

7. If you will (or did) stay overnight where will (or did) you stay?

(Check as many as applicable with the number of days at each)

- a) Hotel/motel _____
- b) Friends/relatives _____
- c) Camping _____
- d) Other (Please Specify) _____

8. If Lake Davis were unavailable would you have traveled to the area?

- a) Definitely yes _____
- b) Probably _____
- c) Unlikely _____
- d) Definitely not _____

9. What are (will be) your total local expenditures on your trip to this area?

- | | | | |
|---------------------|----------|-----------------------|----------|
| a) Restaurant Meals | \$ _____ | d) Fishing related | \$ _____ |
| b) Lodging | \$ _____ | e) groceries | \$ _____ |
| c) Transportation | \$ _____ | f) Other local retail | \$ _____ |

10. Are you aware of the presence in Lake Davis of the Northern-Pike, a non-native, predatory fish?

Yes _____ No _____

11. If yes, does that knowledge affect the number of trips you make to Lake Davis Annually?

Yes _____ No _____ Decrease? _____ Increase? _____

12. Do you usually catch your daily limit? Yes _____ No _____

13a. If your answer to the previous question was no, would you fish here more often if you caught twice as many fish daily?

Yes _____ No _____

13b. How many additional trips would you make each year? _____

14a. If you answer to question 12 is yes, would you fish here less frequently if you caught one-half as many fish daily?

Yes _____ No _____

14b. If so, how many fewer trips per year? _____